The first BritGrav meeting, Southampton, 27/28 March 2001

February 7, 2008

Many relativists now working in Britain have good memories of the Pacific Coast, Midwest or Nickel and Dime meetings from their postdocs in the US. So it seemed natural to establish a similar annual meeting in Britain, and the Southampton GR group gave it a try.

The two distinguishing features of the US regional meetings are very short talks, and keeping it simple and cheap. This concept proved a success east of the Atlantic too: 81 people attended, giving 47 10-minute plenary talks over the two days. 12 of the talks were by PhD students, and 8 by postdocs: a proportion we hope to increase in the future!

On the two days, talks were only roughly grouped by subject. The distribution of topics differed noticeably from those of recent US regional meetings. Below are the abstracts of all talks in the order in which they were given. (The electronic preprint references have been added by the organizers at the request of xxx admin, and are indicative only.)

The **BritGrav02** meeting will be organised by Henk van Elst and Reza Tavakol at Queen Mary and Westfield College, London. All enquiries to them: H.van.Elst@qmw.ac.uk and r.tavakol@maths.qmw.ac.uk.

1. Carlos Sopuerta, U Portsmouth, carlos.sopuerta@port.ac.uk

   Dynamics of irrotational dust matter in the long wavelength approximation

   We report results on the long wavelength iteration of the general relativistic equations for irrotational dust matter in the covariant fluid approach. In particular, we discuss the dynamics of these models during the approach to any spacelike singularity where a BKL-type evolution is expected, studying the validity of this approximation scheme and the role of the magnetic part of the Weyl tensor.

2. Spyros S Kouris, U York, ssk101@york.ac.uk

Large-distance behavior of graviton two-point functions in de Sitter spacetime (gr-qc/0004097)

It has been observed that the graviton two-point functions in de Sitter spacetime in various gauges grow as the distance between the two points increases. We show that this behavior is a gauge artifact in a non-covariant gauge. We argue that it is also a gauge artifact in a two-parameter family of covariant gauges. In particular, we show that the two-point function of the linearized Weyl tensor is well-behaved at large distances.

3. Stanislav Babak, U Cardiff, Stanislav.Babak@astro.cf.ac.uk

   Finite-range gravity and its role in cosmology, black holes and gravitational waves

   The Field Theoretical approach to gravity provides us with a natural way to modify general relativity. In this paper we have considered a two parameter family of theories of a finite-range gravitational field. To give a proper physical interpretation, we have considered the exact solutions of linearised equations. They describe plane gravitational waves and static spherically symmetric gravitational field. A certain choice of sign of the free parameters allows us to associate these free parameters with the rest masses of longitudinal and transverse gravitons. In the static and spherically symmetric problem we have obtained Yukawa-type gravitational potentials instead of Coulomb-type and the gravitational field becomes finite ranged. Applying the theory of finite-range gravitational field to the homogeneous and isotropic Universe, we have shown that even a very small mass of longitudinal graviton can drastically alter the late-time evolution of the Universe. According to the sign of the free parameters, the expansion of the Universe either slows down or gains an additional acceleration. Numerical and semi-analytical solutions of the exact field equations for the static and spherically symmetric problem (Schwarzschild-like solution) were obtained. It has been demonstrated that the event horizon occurs at the location of the physical singularity. That is, a regular event horizon is unstable with respect to ascribing graviton with a non-zero rest mass.

4. Cristiano Germani, U Portsmouth, Cristiano.Germani@port.ac.uk

   Gravitational collapse in the brane

   Abstract: We discuss some aspects of gravitational collapse in the brane world scenario, focusing on the 4-D brane and new features arising from the modified Einstein equations. In particular we report results on collapse of a pure Weyl field and the possible formation of a pure Weyl-charged black hole whose metric is formally that of Reissner-Nordstrom, but with no mass and a negative charge term.

5. Jorma Louko, U Nottingham, jorma.louko@maths.nottingham.ac.uk

Brane worlds with bolts

We construct a brane-world model that has one compact extra dimension on the brane, two extra dimensions in the bulk, and a nonvanishing bulk magnetic field. The main new feature is that the bulk has no horizons that could develop singularities upon the addition of perturbations. The static scalar propagator is calculated on the brane and shown not to see the extra dimensions in the large distance limit. We argue, in part on grounds of an exact nonlinear gravitational wave solution on the brane-world background, that a similar result should hold for linearised gravity.

6. M.L. Fil'chenkov, Peoples' Friendship University, Moscow, fil@agmar.ru

   Tunnelling models of creation and collapse

   The early Universe and late collapse are considered in terms of quantum tunnelling through some potential barrier constructed from Einstein's equations. Wave functions, energy levels and a penetration factor are calculated for these quantum systems. Applications to creation of a universe in the laboratory, observational cosmology and miniholes are discussed. A possibility of the creation of open and flat models as well as a role of quintessence (de Sitter vacuum, domain walls and strings) in these processes are investigated.

7. Henk van Elst, Queen Mary and Westfield College, henk@gmunu.mth.uct.ac.za

   Scale-invariant dynamics for Abelian G2 perfect fluid cosmologies

   A dynamical formulation at a derivative level $\partial^2 g$ for Abelian G2 perfect fluid cosmologies is introduced that employs scale-invariant autonomous evolution systems of symmetric hyperbolic format. This allows for a transparent isolation of (i) the physical degrees of freedom in both the gravitational and the matter source fields and (ii) the gauge degrees of freedom associated with the time slicing. In addition, the self-similar (asymptotic) states can be determined systematically. Various applications are highlighted.

8. Sonny Khan, U Aberdeen, S.Khan@maths.abdn.ac.uk

   Projective symmetries in space-times

   The existence of proper projective vector fields is discussed in Einstein-Maxwell and spherically symmetric static space-times. The problem is resolved for null Einstein-Maxwell space-times (where none can exist) and under certain restrictions in the non-null case (where none have so far been found to exist). Examples of such vector fields are provided in spherically symmetric static space-times, where a general solution (under a loose restriction) is presented.

9. Ghulam Shabbir, U Aberdeen, shabbir@maths.abdn.ac.uk

   Curvature collineations for certain space-time metrics

   A approach is suggested using the 6x6 form of the curvature tensor to find the complete set of curvature collineations (CCs) in space- times which possess certain types of (metric) symmetry. This approach immediately rules out the possibilities where proper CCs cannot exist and suggests how to find CCs when they do. The space-times considered include those with plane and spherical symmetric, static symmetry.

10. Graham Hall, U Aberdeen, gsh@maths.abdn.ac.uk

    Orbits of symmetries in space-times

    The subject of the orbits of symmetries in general relativity is usually discussed in an ad-hoc way. The object of this talk is to try to clarify the position and to offer precise definitions and outline rigorous proofs. The questions to be answered (totally or partially) include

    (i) exactly what are these symmetries, how are they and their orbits described and in what sense,if any, are they groups?

    (ii) how do the standard geometrical invariants behave on an orbit?

    (iii)what are "fixed points" of symmetries, what happens there and where can they occur?

    (iv) are there "well behaved" and "badly behaved" orbits and if so, how does one distinguish between them and do the well behaved ones behave as in the "folklore" of the subject?

    (v) what rules determine the dimension and type of an orbit once the symmetries are specified?

11. Raul Vera, Queen Mary and Westfield College, R.Vera@qmw.ac.uk

    Matching preserving the symmetry

    In the literature, the matchings between spacetimes have been most of the times implicitly assumed to preserve the symmetry. But no definition for such a kind of matching was given until very recently. Loosely speaking, the matching hypersurface is restricted to be tangent to the orbits of a desired group of isometries admitted at both sides of the matching and thus admitted by the whole matched spacetime. This restriction can lead to conditions on the properties of the preserved group of isometries, such as its algebraic type and the geometrical xproperties of the vector fields that generate that group.

12. Bill Bonnor, QMW, 100571.2247@compuserve.com

    Equilibrium of classical spinning particles

Using an approximation method I investigate the stationary axisymmetric solution for two spinning mass particles. It contains, as expected, a conical singularity between the particles representing a strut preventing collapse. However, there is a second singularity which seems to represent a torque preserving the spins of the particles. For certain values of the spins no torque is needed.

It does not seem possible to explain this solution in terms of classical mechanics.

13. Alan Barnes, Aston University, barnes@aston.ac.uk

    On some perfect fluid solutions of Stephani

    Some years ago Stephani derived several solutions for a geodesic perfect fluid flow with constant pressure. In this paper Stephani's solutions with non-zero rotation are generalised; all are of Petrov type D and the magnetic part of the Weyl tensor vanishes. In general the solutions admit no Killing vectors and the fluid flow is shearing, twisting and expanding. The solutions can all be matched across a time-like hypersurface of constant curvature to a de Sitter or Minkowski spacetime.

    A generalisation of Stephani's ansatz is also considered. The general solution in this case has not yet been derived, but some very simple exact solutions for a fluid with spherical symmetry have been obtained.

14. Brian Edgar, U Linkoping, bredg@mai.liu.se

    Tetrads and symmetry

    Two of the main successful tools in the search for exact solutions of Einstein's equations are tetrad formalisms and symmetry groups. However, when these two methods are used together there is a lot of redundancy in the calculations, and the two methods do not complement each other. Chinea, Collinson and Held have in the past looked at the possibility of introducing symmetry conditions at tetrad level, and more recently Fayos and Sopuerto have proposed a new approach to integrating tetrads and symmetry. Building on the results of Chinea, Collinson and Held we propose and illustrate a method which analyses easily and efficiently the Killing vector structure of metrics as they are calculated in tetrad formalisms.

15. Fredrik Andersson, U Linkoping frand@mai.liu.se

    Potentials and superpotentials of symmetric spinor fields

    In 1988 Illge proved that an arbitrary symmetric (n,0)-spinor field always has an (n-1,1)-spinor potential, which is symmetric over its n-1 unprimed indices. In particular this gives an alternative proof for the existence of a Lanczos potential of the Weyl spinor. Illge also considered the problem of

finding completely symmetric spinor potentials for completely symmetric spinor fields having both primed and unprimed indices. Because of algebraic inconsistencies it turned out to be impossible to prove a general existence theorem for these potentials. However, in one important special case it is possible to prove existence of completely symmetric spinor potentials. In an Einstein spacetime it turns out that if we look for potentials for spinors having only one primed index, the algebraic inconsistencies collapse into differential conditions which can be satisfied using gauge freedom. Thus, in Einstein spacetimes, completely symmetric (n,1)-spinor fields always has a completely symmetric (n-1,2)-spinor potential. This means that the Weyl spinor of an Einstein spacetime always has a completely symmetric (2,2)- spinor potential. This 'superpotential' seems to be related to quasi-local momentum of the Einstein spacetime.

16. Annelies Gerber, Imperial College, annelies.gerber@ic.ac.uk, and Patrick Dolan, Imperial College, pdolan@inctech.com

    The Lanczos curvature potential problems with applications

    The Weyl- and Riemann curvature tensors have both been analysed in terms of a tensor potential L_{abc}. The Weyl-Lanczos system of PDE's is always in involution but the Riemann-Lanczos system needs prolongation to be in involution in general. Examples to illustrate these problems are given.

17. Robin Tucker, U Lancaster, r.tucker@lancaster.ac.uk

    On the detection of scalar field induced spacetime torsion (gr-qc/0104050)

    It is argued that the geodesic hypothesis based on autoparallels of the Levi-Civita connection may need refinement in the Brans-Dicke theory of gravitation. Based on a reformulation of this theory in terms of a connection with torsion determined dynamically in terms of the gradient of the Brans-Dicke scalar field, we compute the perihelion shift in the orbit of Mercury on the alternative hypothesis that its worldline is an autoparallel of a connection with torsion. If the Brans-Dicke scalar field couples significantly to matter and test particles move on such worldlines, the current time keeping methods based on the conventional geodesic hypothesis may need refinement.

18. Julian Barbour, jbarbour@online.rednet.co.uk

    Relativity without relativity (gr-qc/0012089)

    I shall give a brief review of the above paper by myself and Brendan Foster and Niall Murchadha. We give a new derivation of general relativity based entirely on three dimensional principles. We start with a parametrisation invariant, Jacobi-type action on superspace. This will be the product of a square root of a potential times the square root of a kinetic energy

term. All we demand is that the action have nontrivial solutions. We find that the only viable action is the Baierlein-Sharp-Wheeler Lagrangian and thus we recover G.R. We impose no spacetime conditions whatsoever. We extend this to include scalar and vector fields. We recover causality (everything travels at the same speed), Maxwellian electrodynamics, and the gauge principle. Thus we derive a large part of modern physics from a purely three dimensional point of view. (gr-qc/0012089)

19. Petros Florides, Trinity College Dublin, florides@maths.tcd.ie

    The Sagnac effect and the special theory of relativity

    Contrary to the recent claim by Dr A.G. Kelly and Professor J.P. Vigier, it is shown, in two distinct ways, that the Sagnac Effect and Special Relativity are in complete and perfect harmony.

20. John Barrett, U Nottingham, John.Barrett@nottingham.ac.uk

    Quantum Gravity and the Lorentz group

    I will give a brief summary of the state of progress of models of 4d quantum gravity based on the representation theory of the Lorentz group, and its future prospects.

21. Christopher Steele, U Nottingham, Christopher.Steele@maths.nottingham.ac.uk

    Asymptotics of relativistic spin networks

    I will discuss Relativistic Spin Networks based on the representation theory of the 4 dimensional rotation group. I will present asymptotic formulae for the evaluation of particular networks and provide a geometrical interpretation.

22. Robert Low, U Coventry, mtx014@coventry.ac.uk

    Timelike foliations and the shape of space

    What is the shape of space in a space-time? In the familar case of a globally hyperbolic space-time, one natural answer is to consider the topology of a Cauchy surface. However, there are other approaches which one might also consider. One is to consider edgeless spacelike submanifolds of the space-time; another is to foliate the space-time by timelike curves, and consider the quotient space obtained by identifying points lying on the same curve. I will describe conditions on the family of timelike curves, and on a vector field whose integral curves they are for this to give rise to a meaningful shape of space, and briefly discuss the relationship between this approach and that of considering edgeless spacelike submanifolds.

23. Jonathan Wilson, U Southampton, jpw@maths.soton.ac.uk

    Generalised hyperbolicity in singular space-times (gr-qc/0001079, gr-qc/0101018)

A desirable property of any physically plausible space-time is global hyperbolicity. It is shown that a weaker form of hyperbolicity, defined according to whether the scalar wave equation admits a unique solution, is satisfied in certain space-times with weak singularities such as those containing thin cosmic strings or shells of matter. It therefore evident that such weak singularities may be regarded as internal points of space-time.

24. Rod Halburd, U Loughborough, R.G.Halburd@lboro.ac.uk

    Painleve analysis in General Relativity Speaker: Rod Halburd, Dept Mathematical Sciences, Loughborough University

    Painleve analysis uses the singularity structure of solutions of a differential equation in the complex domain as an indicator of the integrability (solvability) of a differential equation. A large class of charged spherically symmetric models will be identified and solved using this method.

25. Magnus Herberthson, U Linkping, maher@mai.liu.se

    A nice differentiable structure at spacelike infinity (gr-qc/9712058)

    By a conformal rescaling and compactification of the (asymptotically flat) physical space-time, spacelike infinity is represented by a single point. It it known that the regularity of the manifold at that point cannot be smooth, and various differentiable structures have been suggested. In this talk we report that in the case of a Kerr solution, the standard C¿1-structure can be extended to include both spacelike and null directions from spacelike infinity.

26. Jonathan Thornburg, U Vienna, jthorn@thp.univie.ac.at

    Episodic self-similarity in critical gravitational collapse (gr-qc/0012043)

    I report on a new behavior found in numerical simulations of spherically symmetric gravitational collapse in self-gravitating SU(2) σ models at intermediate gravitational coupling constants: The critical solution (between black hole formation and dispersion) closely approximates the continuously self-similar (CSS) solution for a finite time interval, then departs from this, and then returns to CSS again. This cycle repeats several times, each with a different CSS accumulation point. The critical solution is also approximately discretely self-similar (DSS) throughout this whole process.

27. Jose Maria Martin Garcia, U Southampton, jmm@maths.soton.ac.uk

    Stability of Choptuik spacetime in the presence of charge and angular momentum.

    We show that Choptuik spacetime is a codimension-1 exact solution of the full Einstein - Maxwell - Klein-Gordon problem. That is, electromagnetic field perturbations, charged scalar perturbations and perturbations with

angular momentum all decay. Only the well known spherical neutral perturbation linking Chopuik spacetime with Schwarzschild and Minkowski is unstable. We calculate critical exponents for charge and angular momentum for near critical collapse.

28. Elizabeth Winstanley, U Sheffield, e.winstanley@sheffield.ac.uk

    Update on stable hairy black holes in AdS

    Black holes in anti-de Sitter space can support gauge field hair which is stable under spherically symmetric perturbations. This talk discusses recent work showing that these black holes remain stable under non-spherically symmetric perturbations in the odd-parity sector.

29. VS Manko, CINVESTAV - IPN, VladimirS.Manko@fis.cinvestav.mx

    Equilibrium configurations of aligned black holes

    The existence of multi-black hole equilibrium configurations in different axisymmetric systems is discussed.

30. Colin Pendred, U Nottingham, Colin.Pendred@maths.nottingham.ac.uk

    Black hole formation in (2+1)-dimensional relativity

    The non-spinning BTZ black hole is introduced and shown that it can be formed by the collision of two point particles in (2+1)-dimensional spacetimes of negative cosmological constant. The more general, spinning BTZ black hole is then considered.

31. Atsushi Higuchi, U York, ah28@york.ac.uk

    Low-energy absorption cross sections of stationary black holes (gr-qc/0011070)

    We present a special-function free derivation of the fact shown first by Das, Gibbons and Mathur that the low-energy massless scalar absorption cross section of a spherically symmetric black hole is universally given by the horizon area. Our derivation seems to generalize to any stationary black holes.

32. Brien Nolan, Dublin City U, brien.nolan@dcu.ie

    Stability of naked singularities in self-similar collapse (gr-qc/0010032)

    We show that spherically symmetric self-similar space-times possessing naked singularities are stable in the class of spherically symmetric self-similar space-times obeying the strong and dominant energy conditions. The discussion is restricted to space-times obeying a 'no pure outgoing radiation' condition.

33. Richard I Harrison, U Oxford, harrison@maths.ox.ac.uk

    A numerical study of the Schroedinger-Newton equation

I wish to report on a numerical study of the Schroedinger-Newton equations, that is the set of nonlinear partial differential equations, consisting of the Schroedinger equation coupled with the Poisson equation. The nonlinearity arises from using as potential term in the Schroedinger equation the solution of the Poisson equation with source proportional to the probability density. Penrose [1] has suggested that the stationary solutions of the Schroedinger Newton equation might be the 'preferred basis' of endpoints for the spontaneous reduction of the quantum-mechanical wave-function.

I have computed stationary solutions in the spherically symmetric and the axially symmetric cases, and then tested the linear stability of these solutions. All solutions are unstable except for the ground state. In the spherically symmetric case, I have considered the general time evolution which confirms the picture from linear theory and shows that the general evolution leaves a lump of probability in the ground-state, while the rest disperses to infinity. In the z-independent time evolution, initial indications are that lumps of probability orbit around each other before dispersing.

[1] R Penrose Phil.Trans.R.Soc.(Lond.)A 356 (1998) 1927

34. Paul Tod, U Oxford, tod@maths.ox.ac.uk

    Causality and Legendrian-linking

    A point p in Minkowski space M can be determined by its 'sky', which is to say the set S_p of null-geodesics through it in the space N of all null-geodesics. It was suggested by Penrose, and proved in his thesis by Robert Low [1], that causal relations in M are reflected by linking in N. Thus two points p and q are time-like separated in M if their skies are linked in N, and space-like separated if their skies are unlinked (if they are null separated then evidently their skies meet). Penrose also suggested that this relationship should continue to hold for curved but, say, globally-hyperbolic space-times $\mathcal{M}$. This is much harder. It was explored by Low and later by my student José Natario. It seems to be true in $2+1$-dimensions but is not true in $3+1$, where one has explicit counter-examples. Rather than give up, one can change the question: spaces of null geodesics are contact manifolds and skies are Legendrian submanifolds, so one can ask instead are points causally-related iff their skies are Legendrian-linked - that is, can they be unlinked while remaining Legendrian? There are partial answers and various interesting developments here, and I will describe progress on this programme.

    [1] RJ Low *Twistor linking and causal relations* Class.Quant.Grav.**7**(1990) 177-187

35. Tim Sumner, Imperial College, t.sumner@ic.ac.uk

Fundamental physics experiments in space

There is a wide interest in the UK in carrying out, so-called, 'Fundamental Physics' experiments in space. Earlier this year the space community produced a summary document for the PPARC SSAC. This talk will summarise that document, which contains suggestions for a number of experiments to do with gravity as this is one area in which the use of space is particularly beneficial.

36. Mike Plissi, U Glasgow, m.plissi@physics.gla.ac.uk

    The GEO 600 gravitational wave detector

    A number of interferometer-based gravitational wave detectors are currently being constructed in several countries. The GEO 600 detector, which is being built near Hannover, Germany, is a 600 m baseline instrument that utilises a Michelson interferometric scheme. The instrument will target the frequency band above about 50 Hz. A basic description of the detector will be given with a report of its current status.

37. Oliver Jennrich, U Glasgow, o.jennrich@physics.gla.ac.uk

    LISA: A ESA Cornerstone mission to detect low frequency gravitational waves.

    LISA, a space-borne interferometric gravitational wave detector has been recently approved as a ESA Cornerstone Mission. LISA makes use of interferometry very similar to the ground-based detectors (LIGO, VIRGO, GEO600, TAMA) but is designed to detect gravitational waves in a much lower frequency band of 0.1 mHz to 100 mHz.

    The main objective of the LISA mission is to learn about the formation, growth, space density and surroundings of massive black holes for which there is a compelling evidence to be present in the centers of most galaxies, including our own.

    Observations of signals from these sources would test General Relativity and particularly black-hole theory to unprecedented accuracy.

38. Mike Cruise, U Birmingham, amc@star.sr.bham.ac.uk

    Very high frequency gravitational wave detectors

    A number of theoretical models of the early Universe predict spectra of stochastic gravitational waves rising with frequency. Such spectra satisfy all the known observational upper limits. Detectors are needed in the Megahertz and Gigahertz ranges to detect this radiation. A prototype of one such detector is now in operation and the prospects of it achieving useful sensitivities will be discussed.

39. Edward Porter, U Cardiff, Edward.Porter@astro.cf.ac.uk

An improved model of the gravitational wave flux for inspiralling black holes

While the orbital energy for an inspiralling binary is known exactly for both the Schwarzchild and Kerr cases, an exact expression for the gravitational wave flux remains elusive. All current analytical models rely on a Post-Newtonian expansion. This has given us a Taylor expansion for the flux in the test-mass case to $v^1 1$ for the Schwarzchild case, and to v^8 for the Kerr case. The problem with the Taylor approximation is the slow rate of convergence at various approximations. It has been shown that using Pade Approximation gives a better convergence for the flux in the Schwarzchild case. In this work I propose a method for improving the convergence of the flux in the Schwarzchild case by using a modified Pade Approximation and extend the previous work to the Kerr case. The most interesting result from the Kerr case is that we may be able to closely model a Kerr system with some real value of the spin parameter 'a' with a Pade Approximation using a 'wrong' value of 'a'. We also provide scaling laws at various approximations to recover the true spin of the system from the Pade Approximation.

40. Anna Watts, U Southampton

    Neutron stars as a source of gravitational waves

    We examine the evolution of the r-mode instability for a magnetized neutron star accreting large amounts of remnant matter in the immediate aftermath of the supernova. We discuss the implications for neutron star spin rate and gravitational wave signal.

41. John Miller, SISSA / U Oxford, miller@sissa.it

    Non-stationary accretion onto black holesx

    Update on our project for using computer simulations to investigate different pictures for non-stationary accretion onto black holes. This has relevance for explaining observed time-varying behaviour of galactic X-ray sources and AGN and, possibly, the formation of jets.

42. Uli Sperhake, U Southampton, us@maths.soton.ac.uk

    A new numerical approach to non-linear oscillations of neutron stars

    Radial oscillations of neutron stars are studied by decomposing the fundamental variables into a background contribution (taken to be the static TOV-solution) and time dependent perturbations. The perturbations are not truncated at some finite order, but are evolved according to the fully nonlinear evolution equations, which can be written in quasi linear form in our case. The seperation of the background allows us to study oscillations over a wide range of amplitudes with high accuracy. We monitor the onset of nonlinear effects as the amplitude is gradually increased. Problems

encountered at the surface in any Eulerian formulation, i.e. the singular behavior of the equations in the nonlinear as well as the linearised case and its impact on our results is briefly discussed.

43. Philippos Papadopoulos, U Portsmouth, philippos.papadopoulos@port.ac.uk

    Non-linear black hole oscillations (gr-qc/0104024)

    The dynamics of isolated black hole spacetimes is explored in the non-linear regime using numerical simulations. The geometric setup is based on ingoing light cone foliations centered on the black hole. The main features of the framework and the current status of the computations will be presented.

44. Felipe Mena, Queen Mary and Westfield College, F.Mena@qmw.ac.uk

    Cosmic no hair: second order perturbations of de Sitter universe

    We study the asymptotic behaviour of second order perturbations in a flat Friedmann-Roberstson-Walker universe with dust plus a cosmological constant, a model which is asymptotically de Sitter. We find that as in the case of linear perturbations, the nonlinear perturbations also tend to constants, asymptotically in time. This shows that the earlier results concerning the asymptotic behaviour of linear perturbations is stable to nonlinear (second order) perturbations. It also demonstrates the validity of the cosmic no-hair conjecture in such nonlinear inhomogenuous settings.

45. Kostas Glampedakis, U Cardiff, Costas.Glampedakis@astro.cf.ac.uk

    Scattering of scalar waves by rotating black holes (gr-qc/0102100)

    We study the scattering of massless scalar waves by a Kerr black hole, by letting plane monochromatic waves impinge on the black hole. We calculate the relevant scattering phase-shifts using the Prüfer phase-function method, which is computationally efficient and reliable also for high frequencies and/or large values for the angular multipole indices (l,m). We use the obtained phase-shifts and the partial-wave approach to determine differential cross sections and deflection functions. Results for off-axis scattering (waves incident along directions misaligned with the black hole's rotation axis) are obtained for the first time. Inspection of the off-axis deflection functions reveals the same scattering phenomena as in Schwarzschild scattering. In particular, the cross sections are dominated by the glory effect and the forward (Coulomb) divergence due to to the long-range nature of the gravitational field. In the rotating case the overall diffraction pattern is "frame-dragged" and as a result the glory maximum is not observed in the exact backward direction. We discuss the physical reason for this behaviour, and explain it in terms of the distinction between prograde and retrograde motion in the Kerr gravitational field. Finally, we

also discuss the possible influence of the so-called superradiance effect on the scattered waves.

46. Reinhard Prix, U Southampton, rp@maths.soton.ac.uk

    Covariant multi-constituent hydrodynamics (gr-qc/0004076)

    I will discuss the covariant formulation of hydrodynamics derived from a "convective" variational principle by Carter. This approach allows a convenient generalisation to several interacting fluids (incorporating the effect known as "entrainment") and to superfluids. Such a framework is therefore very well suited to neutron star applications, some of which I will briefly describe here.

47. Ian Jones, U Southampton, dij@maths.soton.ac.uk

    Gravitational waves from freely precessing neutron stars (gr-qc/0008021)

    The free precession of neutron stars has long been cited as a possible source of detectable gravitational radiation. In this talk we will examine the problem of calculating the gravitational radiation reaction on a star, which we model as an elastic shell containing a fluid core. We will conclude by assessing the likely gravitational wave amplitudes of precessing neutron stars in our Galaxy.

    The following talks were also scheduled, but the speakers had to cancel:

48. Bernard S. Kay, U York, bsk2@york.ac.uk

    New paradigm for decoherence and for thermodynamics, new understanding of quantum black holes (hep-th/9802172, hep-th/9810077)

    I outline my recent proposed new explanation for decoherence and for entropy increase based on my new postulate that the "quantum gravitational field is unobservable" and on my related new postulate that "physical entropy is matter-gravity entanglement entropy". I also recall how this proposal offers a resolution to a number of black-hole puzzles, including the "information loss puzzle".

49. Alberto Vecchio, U Birmingham, vecchio@aei-potsdam.mpg.de

    Searching for binary systems undergoing precession with GEO and LIGO (gr-qc/0011085)

    The search for binary systems containing rapidly spinning black holes poses a tremendous computational challange for the data analysis of gravitational wave experiments. We present a short review of our present understanding of the key issues and discuss possible strategies to tackle efficiently the problem.